

MOLLUSCA OF THE OZARKIAN FAUNA.

BY H. A. PILSBRY AND JAMES H. FERRISS.

In the midst of the valley of the greatest river of the continent the Ozark Mountains stand above the plain. On the east and south they are bordered by lowlands scarcely a hundred feet above sea level, and westward the great plains stretch to the foothills of the Rockies. The Ozarks rise to no considerable height, the highest point, Magazine Mountain, in Logan Co., Ark., attaining to 2,823 feet; but the rough topography, in strong contrast with that of surrounding regions, affords conditions favoring the evolution of special forms, species or races, adapted to these conditions. Many of these forms have probably been evolved just where we now find them, and where they are in a measure isolated by the absence or rarity of similar haunts in the lower and more level country surrounding the mountainous area.

Some aquatic forms, *Unionidæ* and *Pleuroceratidæ*, are also peculiar to the Ozark region, though in the main Mississippian species rule.

During the greater part of March and April, 1903, the authors collected at numerous places in the western Ozarks, in southwestern Missouri, western Arkansas, and Indian Territory, the localities selected being supplemental to those worked by Mr. Ferriss in 1900 and 1901. The results of our work are herein dealt with.

I. FAUNAL RELATIONS OF THE OZARK REGION.

The Alleghanian (= Transition of Merriam), Carolinian (= humid Upper Austral) and Austroriparian (= humid Lower Austral) zones as mapped by Dr. Merriam,¹ in eastern North America, are probably reflected as clearly in land molluscan distribution as in that of vertebrates and plants, though of course there is broad overlapping of faunas, and the smaller details of the zonal limits remain to be determined by diligent local work. In the Northern States, this local amplification may well be based upon Dr. Merriam's map; but in the Southern Appalachian system some significant discrepancies appear when the land mollusks are compared with vertebrate distribution.

¹ Life Zones and Crop Zones of the United States, *Bulletin* No. 10, U. S. Department of Agriculture, Division of Biological Survey, 1898.

The Boreal (Canadian) areas mapped by Merriam in Kentucky, Tennessee and North Carolina have for mollusca no faunal connection with or resemblance to the Canadian zone fauna of the northern mountains and Canada. There is no evidence that the northern fauna invaded these heights during the Ice Age, but much evidence to the contrary.² Had such an incursion taken place, it seems hardly conceivable that no *Vitrina*, *Pupilla*, *Vertigo* or northern *Zonitidae* should remain to tell the tale. A certain ill-defined zonal distribution dependent on elevation may be traced, the mountain tops having a poorer fauna than the lower levels, with dwarfed races of some species and a few special species; but the zoological affinities of the forms are in the main with those of the lower coves, not with snails of higher latitudes.

This illustrates what has been recognized by a few zoologists working in other departments, that transcontinental "life-zones" have no necessary connection with the larger facts of faunal distribution, but define secondary divisions, parallel, so to speak, all over the world. For instance equal zones in the southern Alleghenies and the Rocky Mountains might be spoken of as "physically homologous," but not faunally so.

In eastern North America we have, leaving the Floridian tropical element out of the account, two faunas of inland mollusca, developed in diverse areas: (1) the Boreal fauna, consisting of Holarctic species or genera, such as *Vitrina*, *Zonitoides*, *Encomulus*, *Acanthinula*, *Valonia*, *Pupilla*, *Punctum*, *Sphyradium*, *Lymnaea*, etc., which apparently had their rise in the north, and (2) the Appalachian fauna, consisting of forms characteristic of the eastern United States, such as the *Mesodon*, *Triodopsis* and *Stenotrema* groups, *Omphalina*, *Vitrinizonites*, *Paravitrca*, *Gastrodonta*, the *alternata* group of *Pyramidula*, *Helicodiscus*, etc. From what we know of the Pliocene land shells, and those of the interglacial and post-glacial Loess, it is clear that these faunas must have been already as distinct at the close of the Pliocene as at present; and in the case of the Appalachian fauna, we have every reason to believe that its ancestors occupied eastern North America during tertiary time, and how much farther back no man can say.³

² See in this connection, Pilsbry, Mollusca of the Great Smoky Mountains, *Proc. A. N. S. Phila.*, 1900, pp. 110-150, and Walker and Pilsbry, Mollusca of the Mt. Mitchell Region, *Proc. A. N. S. Phila.*, 1902, pp. 413-442.

³ The boreal and southern elements in the east American fauna were fully recognized by Mr. W. G. Binney many years ago. Cf. also Charles C. Adams, Southeastern United States as a centre of geographical distribution of flora and fauna, *Biological Bulletin* III, pp. 115-131, 1902.

From the investigations made by the authors and their friends, it is obvious that there was in the East no extensive glacial recession of the snail fauna southward beyond the border of the ice sheet. It seems likely that the northern fauna of Appalachian origin was largely wiped out, and the survivors crowded with the boreal forms in a band along the States bordering the glaciated area. This comparatively recent concentration of the snail population southward gives at first the impression that the radiation of this element of our fauna was from the southeast, yet during the mild tertiary period favorable conditions certainly existed much farther north than at present, and there seems no more reason to postulate a southeastern than a north-eastern tertiary radiation.

In the more elevated Rocky Mountain region there was obviously a more extensive glacial recession. Boreal genera and species were pushed at least as far as the Mexican boundary, where they still survive at considerable altitudes.

The Appalachian types of land snails now extend over all of the Alleghanian, Carolinian and Austroriparian zones; but within this area we must recognize several strongly individualized faunas characterizing mountainous tracts. These are as follows:

I. The *Austro-Appalachian fauna*, comprising the eastern division of the Appalachian Mountains east of the valley of East Tennessee chiefly in North Carolina, south to Georgia. It is bounded on the north in Virginia and West Virginia by an Alleghanian zone fauna on the highest ridges and a normal Carolinian at lower levels. The Austro-Appalachian fauna has been explored by Dr. Rugel, Mrs. George Andrews, Mr. Wetherby, Messrs. Walker, Sargent, Clapp, and the present authors. It is mapped as Transition and Boreal in Dr. Merriam's Life Zone map of 1897.

II. The *Cumberlandian fauna*, including the western division of the Appalachian Mountain system in Kentucky, Tennessee and northern Alabama. The limits of this fauna extend southwestward beyond the nucleus plotted as Transition in Merriam's map. Our knowledge of this fauna is due to Lea, Binney, Bland, Wetherby, Harper and others. It has been neglected by the present generation of conchologists, but careful collections by Mr. and Mrs. H. H. Smith are now in progress on its southern border (Alabama).

III. The *Ozarkian fauna*, limited to the Ozark uplift, chiefly in Arkansas, but extending into adjacent States north and west. It is largely mapped as humid Upper Austral (= Carolinian) by Merriam.

These three faunas possess but few species in common, aside from

those widespread forms of the whole Carolinian zone, yet they have a similar facies, owing to the rich development of *Stenotrema* and toothed *Zonitidae*, the relative scarcity of *Pupillidae*, etc. It may be that the resemblances are due to parallelism in evolution of the faunas from a common source, yet the possibility may be entertained that the Mississippi embayment, which isolates the Ozark uplift, was crossed by a ridge, permitting rock-living snails to emigrate west from the Cumberland plateau, at some period in tertiary time. This is a geological question aside from our present purpose.⁴ There is no mentionable trace of Boreal zone elements in any of the three southern mountain faunas; and no ground exists in the molluscan fauna. for mapping even the highest peaks as Canadian or Alleghanian.

The Ozarkian fauna is thus one of several mountain faunas of common origin, all traceable to the Appalachian tertiary radiation. The limits of this fauna can be mapped only after much more field investigation, but roughly it includes the broken country of southern Missouri, a small area in southeastern Kansas, the hilly eastern part of Indian Territory, and the greater part of Arkansas, east as far possibly as the 500-foot contour line; but data are absolutely lacking for the definition of its eastern boundary in Arkansas. We know that on the opposite shore of the Mississippi there is no trace of Ozarkian forms. Possibly the upland region of northwestern Louisiana should be added.

On the northwest, north, and northeast of the Ozark area the widespread Carolinian species rule; on the southeast and south the Austroriparian, and on the southwest the uttermost waves of Lower Sonoran life ripple against the rising Ozark mass. The several elements of the fauna are here listed.

1. *Species and subspecies confined to the Ozark fauna:*

Polygyra dorjeuilliana.⁵

d. sampsoni.

d. percostata.

d. perstriata.

jacksoni.

Polygyra j. delloidea.

j. simpsoni.

labrosa.

fraterna imperforata.

pilsbryi.

⁴ Dr. D. S. Jordan writes: "Streams of the Ozark Mountains similar in character to the rivers of East Tennessee have an essentially similar fish fauna, although between the Ozarks and the Cumberland range lies an area of lowland bayous into which such fishes are never known to penetrate." (*Science Sketches*). He suggests that the time of mingling across the lowlands may have been when the intervening region had a colder climate.

⁵ This species spreads southward as far as Galveston, etc., but it is listed here because it is an abundant Ozarkian form, and has three races confined to that area.

<i>Polygyra uncifera.</i>	<i>Polygyra indianorum.</i>
<i>blandiana.</i>	<i>i. lioderma.</i>
<i>inflecta media.</i>	<i>binneyana.</i>
<i>edentata.</i>	<i>b. chastatensis.</i>
<i>e. magazinensis.</i>	<i>kiowaensis.</i>
<i>obstricta occidentalis.</i>	<i>Gastrodonta demissa brittsi.</i>
<i>neglecta.</i>	<i>Omphalina fuliginosa ozarkensis.</i>
<i>cragini.</i>	<i>Vitrea aulacogyra.</i>
<i>exoleta ozarkensis.</i>	<i>significans.</i>
<i>divesta.</i>	<i>simpsoni.</i>

2. *Carolinian species occurring in the Ozark uplift or on its borders* (many of them extending also into the Austroriparian or Sonoran, the latter marked S.):

<i>Polygyra stenotrema.</i>	<i>Euconulus chersinus dentatus.</i>
<i>fraterna.</i>	<i>Agriolimax campestris</i> (S.).
<i>appressa.</i>	<i>Pyramidula solitaria.</i>
<i>a. perigrapta.</i>	<i>alternata.</i>
<i>inflecta.</i>	<i>perspectiva.</i>
<i>elevata.</i>	<i>Helicodiscus parallelus.</i>
<i>albolabris alleni.</i>	<i>Philomycus carolinensis.</i>
<i>thyroides.</i>	<i>Pupoides marginatus</i> (S.).
<i>clausa.</i>	<i>Bifidaria armifera</i> (S.).
<i>Circinaria concava.</i>	<i>contracta</i> (S.).
<i>Omphalina fuliginosa.</i>	<i>procera</i> (S.).
<i>friabilis.</i>	<i>pentodon</i> Say (S.).
<i>Gastrodonta ligera.</i>	<i>tappaniana</i> Ad. (S.).
<i>Zonitoides arborea</i> (S.).	<i>Cochlicopa lubrica</i> . ⁶
<i>minuscule</i> (S.).	<i>Vallonia parvula.</i>
<i>Vitrea hammonis</i> . ⁶	<i>Succinea retusa.</i>
<i>indentata</i> (S.).	<i>ovalis</i> Say.
<i>petrophila.</i>	<i>grosvenori</i> (S.).
<i>multidentata.</i>	<i>avara</i> (S.).

3. *Austroriparian and Sonoran species* (the latter marked S.), extending into the Ozark uplift or to its borders.

⁶ These are more properly Boreal species, extending downward, however, through and below the Alleghanian (Transition) zone.

<i>Helicina orbiculata tropica</i> (S.).	<i>Bulimulus dealbatus</i> .
<i>Polygyra texasiana</i> (S.).	<i>Zonitoides singleyana</i> .
<i>triodontoides</i> .	<i>Euconulus chersinus trochulus</i> (S.).
<i>leporina</i> .	<i>Vertigo rugosula</i> .
<i>fraterna</i> .	<i>Strobilops labyrinthicus texasianus</i>
<i>f. friersoni</i> .	(S.)
<i>f. aliciae</i> .	<i>Helicina orbiculata tropica</i> 'Jan.'
	Pfr. (S.)

About 36 per cent. of the total number of land snails listed are thus peculiar to the Ozark fauna; but when its boundaries come to be more exactly defined, and the finger-like extensions of the Austroriparian and Sonoran areas along the river bottoms are eliminated, the proportion of special forms will probably be increased.

II. ANNOTATED LIST OF SPECIES.

With few exceptions, only the species collected by the authors in March and April, 1903, are treated of here. For a full knowledge of the Ozarkian fauna up to this time, Papers 6, 9 to 25 of the Bibliography appended must be consulted in connection with this.

The specimens reported below were collected by the authors, except when another collector's name is given in parenthesis. Unless otherwise stated, all records are from specimens, not from the literature.

Helicina orbiculata tropica 'Jan' Pfr.

Missouri: Chadwick, Christian Co.

Arkansas: Rogers, Benton Co.; Blue Mt. Station, Logan Co.

Indian Territory: Limestone Gap, Choctaw Nation; Wyandotte.

Polygyra texasiana (Morie.).

Oklahoma City, Okla. (Ferriss). A form with rather weak, irregularly developed striation, similar to the Texan transitions between *P. texasiana* and *P. t. hyperolia*. Also Petit Jean, Ark., and Limestone Gap, I. T. (Ferriss); found by Pilsbry at neither place.

Mr. Sampson reports this species from Sebastian and Nevada Cos. Ark., and from Indian Territory, opposite Fort Smith, Ark.

Polygyra dorfeuilleana Lea.⁷ Pl. XX, figs. 13, 14, 15, 16.

This species is now known to us from the following localities:

⁷ This species was named for Mr. Dorfeuille, of Cincinnati, proprietor of a museum and place of amusement known in 1827 as "Dorfeuille's Hell." Mrs. Trollope, in *Domestic Manners of the Americans*, states that "Cincinnati has not many lions to boast, but among them are two museums of natural history; both of these contain many respectable specimens, particularly that of Mr. Dorfeuille, who has moreover some highly interesting Indian antiquities. He is a man of taste and science. . . . As Mr. Dorfeuille cannot trust to his science for attracting the citizens, he has put his ingenuity into requisition He has constructed a pandemonium in an upper story of his museum, in which he has congregated all the images of horror that his fertile fancy could devise," etc.

Missouri: Warsaw, Benton Co.; Springfield, Green Co.; Chadwick, Christian Co.; Seligman, Barry Co.; Current River, county not recorded. Mr. Sampson adds Camden, Howell, Douglas, Macdonald and Jasper counties (*Nautilus*, VIII, pp. 18, 19). Baker records Arcadia, Iron Co., and J. H. Britts found it in Henry Co. (Walker Coll.).

Kansas: Arkansas City, Cowley Co.

Arkansas: Mammoth Spring, Fulton Co.; Hardy, Sharp Co.; Eureka Springs, Carroll Co.; Rogers, Benton Co.; Van Buren Co.; Chester and Porter, Crawford Co.; Carrion Crow Mt., near Atkins P. O., Pope Co.; Gwynn and Poteau Mts., Sebastian Co.; Blue Mt. Station, Magazine Mt. and Petit Jean Mt., Logan Co.; Hatton Gap, Rich Mt. and Mena and Cove, Polk Co.; Gilham, Chapel Hill, Horatio and Ultima Thule, Sevier Co.; Morris Ferry and Rocky Comfort, Little River Co.; Hot Springs, Garland Co. It has, in addition to these places, been recorded from Hempstead, Nevada, Washington, Franklin, Pulaski, Johnson and Perry counties by Mr. Sampson.

Indian Territory: Wyandotte, Wyandotte Nation; Fort Gibson, Cherokee Nation; Red Fork, Creek Co.; Eufaula, Sugar Loaf Mt., Wister, Poteau, Tushkahoma, Standley, Antlers and Limestone Gap, Choctaw Nation.

Louisiana: Frierson and Nachitoches, Nachitoches Co.; De Soto Co. (Coll. B. Walker); Mt. Lebanon, Bienville Co.

Texas: DeKalb, Bowie Co.; Cooke Co.;⁸ Denison, Grayson Co.; Dallas, Waco; Tarrant Co.;⁸ Washington Co.;⁹ Burleson⁸ and Brazos⁸ counties; Galveston.

These places are plotted on the accompanying map, on which localities for *P. dorfeuilliana* are represented by dots and the variety *sampsoni* by outlined dots. Henry and Camden counties, Mo., are the most northern localities known, and Arcadia, Iron Co., Mo., and the Current River are the easternmost. On the west it is known from Grouse Creek, near Arkansas City, Kan., and throughout the eastern half of the Indian Territory, and in Cooke Co. and Fort Worth, Tex. Southward it penetrates to Washington Co., Tex., in the latitude of Austin.

This species thus inhabits an oblong area about 600 miles long and 300 wide. In Missouri and Arkansas it is not known from the Mississippi lowlands, all known localities being above the 500 feet contour. In Louisiana and Texas, however, it descends to half that elevation,

⁸ On the authority of Mr. J. A. Singley.

⁹ On the authority of W. G. Binney.

but yet, except at Galveston, where it may be imported, it seems to be absent from the very wide and low Gulf border.



Fig. 1.—Distribution of *Polygyra dorfeuilliana* Lea, known localities represented by dots.

The variety *sampsoni* Wetherby, by its more uncoiled spiral, is a more evolved or accelerated race than typical *dorfeuilliana*. It occu-

pies the northern central portions of the area, while the less evolved typical form is peripheral. There is, however, no line to be drawn between them, as in many places both forms and the intergrades occur together, and in the Choctaw Nation especially, most specimens are intermediate in size of the umbilicus.

In 1903 we took the species at eleven localities in Missouri, Arkansas and Indian Territory. Some of the specimens from the bluff along Grand River at Wyandotte, near the northeast angle of Indian Territory, are the largest I have seen, and also the most extreme of the *sampsoni* form, diameter 8 to 9.3 mm. (Pl. XX, figs. 17, 18, 19). Those from Limestone Gap, Indian Territory, and Magazine Mt., Ark., are intermediate in characters. At Mammoth Spring, Fulton Co., northeast Arkansas, only typical *dorfeuilliana* was taken, the shells being small, 6.7 mm. diam. (Pl. XX, fig. 12). This is exactly the size given by Lea for the type, .3 inch.

In originally describing this species, Dr. Lea gave the locality as "Ohio, Mr. Dorfeuille, Cincinnati." Mr. W. G. Binney states that "Mr. J. G. Anthony obtained from Mr. Dorfeuille some facts concerning the original discovery of this species, which prove beyond all doubt that it was accidentally brought from Kentucky." It is on the strength of this that he reports it from "Kentucky, opposite Cincinnati." Binney also records *dorfeuilliana* from "Coosa River, Alabama."

A somewhat extensive correspondence with active collectors has failed to bring out any definite locality for *dorfeuilliana* in Kentucky, Tennessee or Alabama. Inquiry among Cincinnati conchologists has elicited no further confirmation of Mr. Dorfeuille's Kentucky record. Mr. Bryant Walker writes: "There are no *P. dorfeuilliana* from east of the Mississippi, so far as I can find, in the Wetherby collection. I have two specimens labelled 'Ky.' sent me years ago by Anthony, and one from the Lathrop collection from 'Wn. Tennessee.'"

Dr. W. H. Dall, of the U. S. National Museum, under date of October 21, 1905, writes: "I have looked over our series of *dorfeuilliana* Lea. One, marked by Lea 'type,' has the locality 'Cincinnati,' but the label records no collector's name, but the original description credits it to Dorfeuille. There is also a fragment from Florida named by Binney *dorfeuilliana*, but which in my opinion is a fragment of *avara*. The first is No. 116,779, the other 47,318. We do not have it from Alabama. All our series are from Indian Territory, Arkansas, Louisiana, Texas. I feel quite confident the Ohio or Kentucky locality is 'erroneous.'"

Mrs. George Andrews informs us that no specimens from east of the Mississippi have come to her knowledge aside from the records in Mr. Binney's work, already alluded to.

It is our experience that in the trans-Mississippian region where *P. dorjeuilliana* occurs it is a common snail, readily found in all suitable stations, and often in considerable quantity. It is not one of the snails occurring only in restricted localities and requiring special search to find. It seems therefore doubtful whether its range really extends east of the Mississippi at all; and until some definite cis-Mississippian locality for it is put on record, we are disposed to erase Ohio, Kentucky, Tennessee and Alabama from the ascertained range of the species.

The variety *percostata* Pils.¹⁰ (Pl. XX, fig. 23) was based on specimens from the Red River in southwest Arkansas, in which the riblets of the upper surface continue over the base, which is strongly and coarsely rib-striate. The sculpture, however, varies a good deal, even in the original lot of several hundred specimens, most of which are as smooth as the ordinary form of *dorjeuilliana*. The umbilicus, while variable in width, is never so wide as in typical *sampsoni*. The diameter is from 7 to 9 mm.

We hesitate now to treat *P. d. percostata* as a subspecies, yet the tendency in this local race to produce a sculptured base is not present in a great number of other colonies of *dorjeuilliana* which have been studied in thousands of specimens.

P. d. perstriata n. subsp. Pl. XX, figs. 24 (type), 20, 21, 22.

Another incipient race of *P. dorjeuilliana* from Tushkahoma and Poteau, Indian Territory, is open below like *P. d. sampsoni*, but the base is finely and densely striate. In a large series collected the sculpture varies but little.

Other specimens from Mena, Ark. (Pl. XX, figs. 20-22) are smaller, and vary to forms with less distinctly striate base.

Polygyra jacksoni (Bland). Pl. XX, figs. 1-5.

The axis in this species is distinctly perforate at all stages of growth. The upper lip-tooth is deeply placed and very oblique. Viewed from the inside, the spire and parietal wall removed, it is seen to be a narrow oblique lamina. There is no tubercle on the columella inside, at least in the specimens I have opened. The diameter varies ordinarily from 6.5 to 7.5 mm.

The type locality is Fort Gibson, I. T. We collected it copiously in

¹⁰ *Polygyra dorjeuilliana percostata* Pils., Nautilus, XIII, p. 37. Type loc., near Texarkana, Ark., on the Red River.

the Petit Jean Mts., Logan Co., Ark. A few were taken at Blue Mountain Station, Logan Co., Ark.; and in Indian Territory, Wyandotte Nation, at Wyandotte, on the top of the bluff, in dry woods under stones. Some of them are very small, barely over 6 mm. diam. Specimens from Springfield, Mo., are also small, 6.6 to 7 mm. diam.

The localities now known for *P. jacksoni* follow:

Southwestern Missouri: Camden Co.;¹¹ Dade Co.;¹¹ Ash Grove and Springfield, Green Co.; Jasper Co.; Barry Co.;¹¹ Macdonald Co.¹¹

Arkansas: Eureka Springs, Carroll Co.; Washington Co.;¹¹ Rogers, Benton Co.;¹² Porter and Chester, Crawford Co.; Van Buren Co.; Franklin Co.;¹¹ Sebastian Co.;¹¹ Blue Mt. Station and Petit Jean Mts., Logan Co.; Rich Mt. and Mena, Polk Co.¹²

Indian Territory: Wyandotte, Wyandotte Nation; Fort Gibson, Cherokee Nation; Poteau, Choctaw Nation.¹²

The range of the species eastward in northern Arkansas remains to be mapped. On the south its limit is apparently indicated with approximate accuracy, since the explorations of Mr. Ferriss in Arkansas south of Polk county, and of both of us in the adjacent portions of Indian Territory, failed to bring *P. jacksoni* to light.

***Polygyra jacksoni deltoidea* (Simpson).** Pl. XX, figs. 6, 7.

Helix (Polygyra) jacksoni var. *deltoidea* Simps., Proc. U. S. Nat. Mus. 1888, p. 450.

Similar to *P. jacksoni*, except that the front edge of the parietal callous is very thick and raised in an erect triangle. Alt. 3.5, diam. 8 mm., or smaller, diam. 7.5 mm. This form has been found only near Fort Gibson, I. T. It has not before been illustrated. The figures are from cotypes.

***Polygyra jacksoni simpsoni* n. subsp.** Pl. XX, figs. 8, 9, 10, 11.

Larger than *P. jacksoni* and *wholly imperforate*, though the axis is hollow except in the last whorl, and the young shells therefore are perforate. The aperture does not differ from that of *P. jacksoni*, but there is a small tubercle within on the columella, seen upon breaking into the base. Whorls $5\frac{1}{2}$. Alt. 4.7, diam. 9.3 mm. The largest specimen taken measures 9.5 mm. diam., the smallest 8.3 mm.

The types were taken by us near Wyandotte, Wyandotte Nation, in the northeast angle of Indian Territory, on the south bank of Grand River, on a steep rocky bluff facing north. Mr. Simpson found this form near Fort Gibson, I. T., and it may be what Sampson refers to as

¹¹ Recorded on the authority of Mr. F. A. Sampson.

¹² Recorded on the authority of J. H. Ferriss.

a large form of *P. jacksoni* which he took on the bluffs of the Arkansas River at Van Buren, Crawford Co., and in Sebastian Co., Ark., but we have not seen his specimens.

At Wyandotte *P. j. simpsoni* alone is found on the bluff facing the river, while the small typical *jacksoni* occurs in the dry stony woodland at the summit of the bluff. In no case were the two forms found in company.

In 1900 Mr. Ferriss took a specimen of this variety at Mena, Polk Co., Ark. (cf. *Nautilus*, XIV, p. 28, No. 72).

Section *Stenotrema* Raf.

Five species of this group are now known from the Ozark region: *P. stenotrema*, *P. labrosa*, *P. blandiana*, *P. unciifera* and several subspecies of *P. fraterna*. The common Eastern *P. hirsuta* is not known to enter the Ozarks. Mr. Sampson has recorded it from Sedalia, Mo., a place well out of the Ozark fauna. *P. fraterna*, *P. fraterna friersoni* and *P. j. aliciae* are the only *Stenotremes* known to reach so far southwest as Texas.

Polygyra stenotrema ('Fér.' Pfr.).

Not a common snail in the Ozark region, so far as my experience goes. It does not appear in Mr. Singley's Texas list, and I can find no Missouri record, though from its presence at Hardy and Wyandotte it may reasonably be expected over the State lines northward in both Missouri and Kansas, as well as in the still unknown eastern part of Arkansas. The following localities are represented by specimens before us:

Arkansas: Hardy, Sharp Co. (Ferriss); Mabelvale, Pulaski Co. (C. W. Johnson); Petit Jean Mts., south of Hartford, Sebastian Co., one dead shell (Pilsbry and Ferriss); spur of the Chastat Mts., about 6 miles south of Mena, Polk Co. (Ferriss); to which Mr. Sampson adds the records Clark, Garland and Independence counties.

Indian Territory: Wyandotte, Wyandotte Nation (Pilsbry and Ferriss); Fort Gibson, in the Cherokee Nation (E. W. Hubbard). It was also taken at the latter place by C. T. Simpson in 1888.

Polygyra labrosa (Bland).

Proc. A. N. S. Phila., 1903, p. 202, pl. 9, figs. 4-6.

Helix labrosa Bld., Ann. Lyc. N. H. of N. Y., VII, 1862, p. 107, pl. 4, fig. 19.

In 1903 we took this species at eight places in Missouri, Arkansas and Indian Territory. It is quite abundant in most places, and varies but slightly. The recorded range of *P. labrosa* east of the Mississippi in Tennessee and Alabama (see Bland) rests solely upon data and speci-

mens furnished by our conchological forefathers, and no localities more definite than the States mentioned have been given. It may be that the eastern range claimed for this species and *Polygyra dorfeuilliana* will prove to be without foundation in fact. In the West its actually ascertained range is as follows. Except where otherwise stated, we have examined specimens from the localities mentioned:

Missouri: Camden, Benton, Macdonald and Jasper counties;¹³ Springfield, Green Co.;¹³ Marble Cave near Galena, Stone Co.; Seligman, Barry Co.; Chadwick, Christian Co.; Cedar Gap, Wright Co.¹⁴

Arkansas: Mammoth Spring, Fulton Co.; Eureka Springs, Carroll Co.; Rogers, Benton Co.; Van Buren¹³ and Chester,¹⁴ Crawford Co.; Washington,¹³ Franklin,¹³ Conway,¹³ Perry,¹³ and Independence¹³ counties; Carrion Crow Mt.,¹⁴ Pope Co.; Hot Springs, Garland Co.; Washita Springs,¹⁵ Montgomery Co.; Little Rock, Pulaski Co.; Magazine Mt., from the summit down, and Petit Jean Mts., Logan Co.; Poteau Mts., south of Gwynn P. O., Hartford Sta., Sebastian Co.

Indian Territory: Sugar Loaf Mt., northwest of Gwynn P. O., Ark.

These localities are all in the hilly or mountainous country, chiefly in central and western Arkansas, barely reaching over the State border on the west, but extending some distance north into Missouri. Nowhere does the species approach the lowlands of the Mississippi, so far as we know at present; but we are still practically without data on the land molluscan fauna of eastern Arkansas.

In his original description Bland mentioned four localities for *P. labrosa*: Washita Springs and Hot Springs, Ark., Tennessee and Alabama. As neither was designated as typical, I would suggest that Hot Springs, Garland Co., Ark., be selected as the type locality. It has been collected there by Ferriss and others.

There is a *Helix labrosa* of Wood, *Index Testaceologicus*, Suppl., p. 24, pl. 8, fig. 69 (1828), which seems to be identical with *Buliminus labiosus* Müll.

P. (Stenotrema) edgariana might be supposed to inhabit Arkansas, from the range given by Binney, *Man. Amer. Land Shells*, p. 275, but it has not to my knowledge been found west of the Mississippi River, and I doubt its occurrence there.

¹³ Recorded from this locality on the authority of Mr. F. A. Sampson.

¹⁴ Recorded from this locality on the authority of J. H. Ferriss.

¹⁵ Recorded from this locality on the authority of Thomas Bland.

Polygyra monodon (Rack.).

Helix monodon Rackett, Linnean Trans., XIII, 1822, p. 42, pl. 5, fig. 2.

Stenotrema monodon var. *leai* Ward, Binney, Man. Amer. Land Shells, p. 281, fig. 297.

Polygyra monodon Pils., Proc. A. N. S. Phila., 1900, p. 454.

The southern range of typical *P. monodon* (*Stenotrema leai* of authors) seems to barely reach the Ozark region. Mr. F. A. Sampson records it from Sedalia, Pettis Co., and Lamar, Barton Co., Mo., and Carroll, Benton, Washington and Nevada counties, Ark.; also Neosho Co., Kan. We have not ourselves seen Arkansas specimens. The following subspecies replace *P. monodon* in the Southwest.

Polygyra fraterna friersoni Pils.

Nautilus, XIII, p. 36 (1899); Proc. A. N. S. Phila., 1900, pp. 454-456.

The shell is perforate or rarely closed, with $6\frac{1}{2}$ whorls, a long fulcrum, much longer than in *P. f. imperforata*, and no distinct notch at the base of the columella. It is larger than *P. f. aliciae* with more whorls. Numerous localities are given in Pilsbry's paper of 1900, to which the following may be added: Fayette Co., Tex., and Nashville, Tenn., in an open field, collected by A. G. Wetherby. This is the only locality known east of the Mississippi River. The type locality is Frierson, La.

Polygyra fraterna (Say).

It is somewhat peculiar that this form turns up in central Texas, where it was taken by us at and near New Braunfels, and by Pilsbry at Austin about 14 years ago.

Polygyra fraterna imperforata Pils.

Proc. A. N. S. Phila., 1900, p. 455; 1903, p. 204.

We took this form on the Poteau Mts., south of Gwynn P. O. (Hartford Station), Sebastian Co., Ark. It is known also from Rich Mt. and Mena, Polk Co., and Rocky Comfort, Little River Co., Ark. One of the types from the last locality measures: alt. 7.7, diam. 10.5 mm. to alt. 6.7, diam. 9 mm.

Polygyra fraterna aliciae Pils.

Helix monodon var. *aliciae* Pils., Man. Conch., VIII, p. 152. Feb. 25, 1893.

Polygyra monodon aliciae Pils., Proc. A. N. S. Phila., 1900, pp. 454-456; 1903, p. 204.

This form is typically small and elevated with very convex base, narrowly perforate axis, and $5\frac{1}{2}$ to 6 whorls. The degree of elevation varies a good deal. The fulcrum is long and strongly notched above and below. The basal lip has a more or less strongly developed flange on its face, somewhat as in *P. vultuosa*, with a notch where it ends at the columella. Specimens of the type lot from Lake Charles, La., measure from 5 x 7 mm. to 5.7 x 7.8 mm.

We took this subspecies at the following localities: Monett, Barry Co., Mo.; Petit Jean Mts., Sebastian Co., Ark.; Wyandotte, Vinita, Wister, South McAlester and Limestone Gap, Indian Territory.

It is before us from three localities near the northeastern angle of Texas: Gainesville, Cass Co. (Ragsdale); Wood Co. (R. Walton Coll.); and DeKalb, Bowie Co. (Ferriss).

Polygyra obstricta occidentalis n. subsp. Pl. XXII, figs. 30, 31, 32.

Shell imperforate, slightly convex or nearly flat above, very convex beneath; similar to the more strongly carinate form of *P. o. carolinensis*, but differing by the reduced teeth, those of the lip being very small or vestigial. Surface rib-striate, very minutely and densely papillose between the riblets, not coarsely roughened as in *obstricta*. Whorls $4\frac{1}{2}$ to nearly 5, the last slightly descending in front.

Alt. 7.7, diam. 18.7 mm.

Alt. 8.2, diam. 17.8 mm.

Alt. 7, diam. 17 mm.

Alt. 7.5, diam. 16.5 mm.

Northern Arkansas, probably from near Benton, Saline Co. Collected by Prof. Stuart Weller. Collections of Ferriss and A. N. S. Phila.

This form is readily distinguishable by its dwarf stature and much reduced lip-teeth. It is less acutely keeled than typical *P. obstricta*. It is evidently what Mr. Sampson¹⁹ reports from Independence Co., Ark. He found one specimen 20.5 mm. in diameter.

P. obstricta carolinensis (Lea) extends westward in the South to Grand Cane, De Soto Co., La., where it was collected by Mr. George Williamson. Typical *P. obstricta* has not, I believe, been found west of the Mississippi River.

Polygyra inflecta (Say). Pl. XXII, fig. 1.

Missouri: Chadwick, Christian Co.

Arkansas: Rogers, Benton Co.; Blue Mountain Station and Magazine Mountain, both on the north and south sides of the summit, and Petit Jean Mts., Logan Co.; Poteau Mountain, south of Gwynn P. O. (Hartford Station), Sebastian Co.

Indian Territory: Wyandotte, along the Grand River, Wyandotte Nation; Sugar Loaf Mt., Wister and Limestone Gap, Choctaw Nation.

This common snail was everywhere found in abundance; and since in various places it has diverged to form local races or species, some account of its variation may be timely. The type locality given by Thomas Say is "lower Missouri"—that is, along the Missouri River

¹⁹ Mollusca of Arkansas, 1893, p. 186

within the State of Missouri. The type specimen measures alt. 6.2, diam. 11.25 mm., with 5 whorls. The outer lip-tooth recedes a little and is somewhat broad and rounded. The lower or basal tooth is marginal, decidedly narrower than its fellow, and tubercular. The notch between the two teeth is squarish and decidedly wider than deep. See Pl. XXII, fig. 1.

In the stony ravines of the Ozark system at Chadwick, Mo., the extensive series collected shows two forms, which we will call 1 and 2, occurring in the proportion of 13 of form 1 to 38 of form 2, or one to three. Form 1 (Pl. XXII, figs. 2, 3) is nearly typical, but more frequently the outer tooth is as small as the basal. The size varies from 5.2×10 to 7.3×12 mm. Form 2 is more solid, with the aperture more contracted by larger teeth (Pl. XXII, figs. 4-6). The two lip-teeth are subequal, the basal one massive and broadly conic. The notch between them is narrower than in the type, and as deep as it is wide. No specimens reach the size of form No. 1, the extremes measuring 5×9 and 5.3×10 mm. Whether these two forms occurred together or in separate colonies was not noted.

The forms from other localities mentioned above vary from typical to a condition of teeth intermediate between the two forms described. Thus at Wyandotte, near the northeast angle of Indian Territory, intermediate specimens occur in profusion (Pl. XXII, figs. 7, 8). Among them was a mutation with the basal tooth obsolete, singularly like *P. smithi* Clapp, except in the smaller size, diam. 10.4 mm. (fig. 9).

On the northern side of the cliff defining the summit plateau of Magazine Mountain it occurs adjacent to the locality for *P. edentata magazinensis*, though not actually associated with it. The specimens here are mostly small, diam. 9.5 to 11.2 mm. On the drier and warm side south of the summit plateau and in the valley south of Blue Mountain Station, at the southern foot of the mountain, they are equally small. The largest *inflecta* we found were taken in the Petit Jean Mountains, about ten miles south of Magazine Mountain, where they measured 12.3 to 13.8 mm. diam., and usually have the basal lip calloused on the axial side of the basal tooth. The crest behind the lip is also sharp and high.

Polygyra inflecta media Pils. Pl. XXII, fig. 10.

Pilsbry, Proc. A. N. S. Phila., 1903, 197, in text.

Lip-teeth reduced to small tubercles, but still stronger than in *P. edentata*. Seligman, Barry Co., Mo. (Ferriss, 1901). Types No. 81 437 A. N. S. P., cotypes in Ferriss Coll.

This is a further development of *P. inflecta* form No. 1, described above.

Polygyra edentata (Sampson). Pl. XXII, figs. 11, 15, 16.

Triodopsis edentata Sampson, Nautilus, III, p. 85, December, 1889.

Triodopsis edentula Sampson, W. G. Binney, Third Supplement Terr. Moll., V, p. 190.

Polygyra edentata Sampson, Pils., Man. of Conch., VIII, p. 154, pl. 50, figs. 16-18; Proc. A. N. S. Phila., 1903, p. 197.

The original specimens came from the summit of the Boston Mts., at Winslow, Washington Co., Ark. Mr. Sampson found it also at Porter, Crawford Co., and Ferriss took specimens at Chester, in the same county. These localities afford specimens 12 to 14 mm. in diam.

P. edentata differs from *P. inflecta* by the reduction of the two lip-teeth to small and inconspicuous prominences, which however occupy the positions of the prominent teeth in *P. inflecta*. The specimens from Chester have a somewhat sharper, higher crest behind the lip than the others.

Polygyra edentata magazinensis n. subsp. Pl. XXII, figs. 12, 13, 14, 17, 18.

Similar to *P. edentata*, but more contracted behind the lip, and with the aperture less rounded, more triangular, the lower lip-tooth absent, replaced by a low, wide prominence nearer to the columellar end of the basal lip; scale-like cuticular processes well developed.

Alt.....	7	7	7	6.7	7	6	6 mm.
Diam.....	14	13.5	13.3	13	12.5	12	11.5 "

Most of the series of 114 specimens measure from 13 to 14 mm. diameter. All agree in the shape of the aperture and peristome, which varies remarkably little.

Magazine Mountain, Logan Co., Ark., in a talus of large rocks under the cliff on the north side of the summit plateau (Ferriss and Pilsbry March 28-30, 1903). We found a single dead specimen on the south side, near where the road ascends the cliff.

The smallest specimens are distinctly angular at the periphery in front.

Polygyra cragini (Call).

Triodopsis cragini Call, Bull. Washb. Coll. Lab. N. H., I, No. 7, p. 202, fig. 5. December, 1886 (banks of Chetopa Creek, Neosho Co., Kansas).

This small *Triodopsis* varies but little so far as present collections indicate. It borders the Ozark elevation on the west, from Kansas to Texas and Louisiana, the localities known to us by specimens up to this time being as follows:

Southeast Kansas: Nesoho Co. (Crugin); Thayer (Ferriss).

Indian Territory: Vinita, Cherokee Co. (Pilsbry and Ferriss); Red Fork, Creek Co. (Ferriss); McAlester (C. T. Simpson), South McAlester (Pilsbry and Ferriss) and Choctaw City (Ferriss), Choctaw Country.

Western Arkansas: Mena, Polk Co.; Ultima Thule, Sevier Co. (J. H. Ferriss); Rocky Comfort,¹⁷ Little River Co.

Northwestern Louisiana: Frierson, Nachitoches Co. (L. S. Frierson).

Northeastern Texas: Wood Co. (J. A. Singley).

At South McAlester, I. T., we found it under stones and wood on a stony hillside, April 8, 1903.

Polygyra hopetonensis (Shuttlw.). There is a set of four small specimens apparently of this species, stated on the label to be from Fort Gibson, I. T., received by A. D. Brown from E. W. Hubbard (No. 4,718 A. N. S. P.). This is so far from the well-known range of the species (South Carolina to Florida) that we mention the matter merely to provoke further investigation.

Polygyra neglecta Pils. Pl. XXII, figs. 19, 20, 21.

Proc. A. N. S. Phila., 1903, 196.

This species is now known from the following localities:

Missouri: Springfield, Greene Co. (Wetherby); Chadwick, Christian Co. (Ferriss and Pilsbry); near Marble Cave, not far from Galena, Stone Co. (Coll. A. N. S.); Seligman, Barry Co. (Ferriss).

Kansas: Fort Scott, Bourbon Co. (F. A. Sampson); Erie, Neosho Co. (Ferriss).

Arkansas: Eureka Springs, Carroll Co. (Sampson); Rogers, Benton Co. (Ferriss and Pilsbry); Mammoth Spring, Fulton Co.

Indian Territory: Wyandotte, Wyandotte Nation (Pilsbry and Ferriss).

The range of the species indicated by these localities is a small area in the northern and northwestern outliers of the Ozark system, about 200 miles in extent east and west, and about 120 miles north and south. Its distribution northward in Missouri remains to be determined; but southward in Arkansas and Indian Territory it probably does not range much farther, for it would hardly have escaped the notice of Messrs. Sampson, Simpson, Ferriss and myself.

† Several specimens from Mammoth Spring, Fulton Co., near the northern boundary of Arkansas, are not quite typical, yet are decidedly nearer to *neglecta* than to *P. fraudulenta*. Whether *P. neglecta* will stand as a species or be reduced to the rank of a subspecies of *P. fraudulenta* remains to be seen when good collections from the intermediate region between its area and the Mississippi River can be examined.

¹⁷ Reported by Mr. Ferriss, who also gives the locality Hardy, Ark.

Polygyra kiowaensis (Simpson). Pl. XXI, figs. 13, 17-20.

Helix (*Mesodon*) *kiowaensis* Simpson, Proc. U. S. Nat. Mus., 1888, p. 450. Pilsbry, Man. Conch., VIII, p. 155, pl. 50, figs. 13-15, with var. *arkansaensis*, p. 156, pl. 50, figs. 11, 12.

Helix (*Mesodon*) *kiowaensis* Sims., Pilsbry, Proc. A. N. S. Phila., 1889, p. 414, pl. 12, figs. 11, 12 (jaw and teeth).

Polygyra (*Mesodon*) *kiowaensis* Simpson var. *arkansaensis* Pils., Nautilus, IV, p. 131 (March, 1891).

Mesodon kiowaensis Simpson var. *arkansaensis* Pils., Sampson, Moll. of Arkansas, p. 192.

This is a solid, compact little "*Mesodon*," readily distinguished from *P. binneyana* and from the small umbilicate form of *P. indianorum* by its wide spire and narrower last whorl, and by the very narrow expansion of the internally thickened lip, which is without traces of teeth.

It was originally found at Kiowa and Limestone Gap, I. T., two stations (not towns) on the M. K. & T. R. R., where Mr. C. T. Simpson collected in 1888. A single bleached shell was taken at Eufaula, I. T.

In 1903 we worked a few days, April 9-11, at and near the Gap, and on the adjacent Sandstone "Mountains" immediately eastward. Helices were found chiefly under stones, together with copperheads and rattlesnakes. We found *P. kiowaensis* very rare. Pilsbry got two living ones, one of them not full grown, and four dead shells, three of them more or less broken; Ferriss a few more. In all of them the umbilicus is slightly narrower than in a cotype from Kiowa received from Mr. Simpson (Pl. XXI, fig. 20).

On the dry southern slope of Magazine Mountain, Logan Co., Ark., we found several dead and bleached shells similar to those from Limestone Gap, only two entire and one broken, although a great deal of time and labor was spent in the search. They occurred around and under rocks (Pl. XXI, fig. 13).

The only other locality known is from near Hot Springs, Garland Co., Ark., where Mr. Sampson in 1890 found the types of what was described as var. *arkansaensis* (Pl. XXI, figs. 17, 18). These specimens are somewhat more robust than the types of *kiowaensis*, with the aperture slightly larger and the umbilicus smaller. The specimens collected by us at Magazine Mountain and Limestone Gap demonstrate however that the differences in the umbilicus and the shape of the mouth are inconstant; and we are now convinced that the varietal distinction is untenable. The name *arkansaensis* should therefore be dropped.

The scarcity of specimens at the three widely separated localities known, while many intermediate localities have been carefully searched for snails, shows *P. kiowaensis* to be one of the rarest of American Helices.

Measurements of the specimens in Coll. A. N. S. follow, the dimensions of aperture including the peristome:

	Alt.	Diam.	Aperture.	Umbilicus.
Hot Springs.....	{ 9.5	16	7.2 x 9	1.5 mm.
	{ 10	16	8 x 9.2	1.5 "
Magazine Mt.....	{ 9	15.3	7 x 8.8	1.2 "
	{ 9.2	15.2	7.2 x 9	1.2 "
Kiowa.....	{ 8.8	14.5	6.2 x 7.9	1.8 "
	{ 7.7	16	6.7 x 9	1.7 "
Limestone Gap.....	{ 8	15	6.7 x 8.2	1.5 "
	{ 7.8	14	6 x 8	1.5 "
	{	13.3	6 x 7.7	1.3 "

The number of whorls varies from $5\frac{1}{2}$ to $5\frac{1}{2}$.

Polygyra binneyana Pilsbry and Ferriss. Pl. XXI, figs. 9, 10, 11 (Petit Jean Mts.), 12 (Sugar Loaf).

Pils., Nautilus, XIII, p. 38 (August, 1899); Proc. A. N. S. Phila., 1900, p. 451, 1903, p. 201. Ferriss, Nautilus, XIV, pp. 26, 27, 28 (July, 1900).

This beautiful species is closely related to *P. indianorum*, but is readily distinguished from the typical form of that species by its open umbilicus. It is equally easy to separate it from *P. kiowaensis* by the larger aperture and comparatively narrower lip, which is less thickened within and more reflexed. It is found only on the mountains,¹⁸ so far as our experience goes, and chiefly under large stones. It commonly does not seem to be found in the same localities with *P. indianorum*, either the one or the other occupying the ranges where we collected in 1903. Ferriss however got both at Tushkahoma, I. T., a year or two previously. It is now known from the following localities, all of them south of the Arkansas River:

Arkansas: Magazine Mt., Logan Co.; Petit Jean Mts., at the south border of Logan Co., or the northwestern border of Yell Co. (Ferriss and Pilsbry); Mena, Hatton's Gap and Rich Mt., Polk Co., and Gilham and Horatio, Sevier Co. (Ferriss).

Indian Territory: Sugar Loaf Mt. and Wister, Choctaw Nation (Ferriss and Pilsbry); Tushkahoma (Ferriss); Poteau, 21-24 mm. diam. (Ferriss).

The specimens from Indian Territory are much smaller than those from Arkansas, as may be seen from the following table, from which the variation curves may readily be plotted. At Sugar Loaf Mt. the mode is at 19.5 mm. and the largest specimen measures 23 mm. in diam., while in Arkansas the mode is at 24 to 26 mm., and the largest specimen measures 28.2 mm. Curiously enough, at Tushkahoma, where the largest *P. indianorum* were found, *P. binneyana* was small.

¹⁸ Ferriss reports it living under stones in creek bottoms in Sevier and Polk counties, Arkansas. Nautilus XIV, 26-28.

The locality "Hardy, Sharp Co." given in the original description, may possibly be due to an error of some sort, as that place seems out of the general range of the species; yet until a further search is made there, we are not justified in omitting the locality.

Measurements of Polygyra binneyana.

Diam. in mm.	Sugar Loaf Mt., I. T.	Wister, I. T.	Petit Jean Mts., Ark.	Maga- zine Mt., Ark.	Gilham, Ark.	Mena, Ark.
16	1					
16.5						
17	1					
17.5	1					
18	6					
18.5	3	1				
19	8	2				
19.5	9	1				
20	4	9				
20.5	1	3				
21	6	8				
21.5	2	3		1		
22	4	7				
22.5		2	1			
23	1	1	1			
23.5			1			
24		1	4		1	
24.5			2	2		
25			4	2		1
25.5			4	2	1	
26			5	2	1	
26.5						1
27						
27.5				2		
28				1		
Number of specimens	47	38	22	12	3	2

P. binneyana chastatensis n. subsp. Pl. XXI, fig. 16.

In the Chastat Mountains, four miles south of Mena, Polk Co., Ark., Mr. Ferriss found a small race in which the lip is comparatively much wider than in typical *P. binneyana*, but yet differs from *P. kiowaensis* by being strongly reflexed. Types 78,655 A. N. S. P.

Alt. 11, diam. 20 mm., whorls fully 5.

Alt. 10.5, diam. 17.7 mm., whorls 5.

Alt. 9.5, diam. 17.7 mm., whorls $4\frac{3}{4}$.

This is the smaller variety mentioned by Ferriss, *Nautilus*, XIV, p. 29.

Polygyra indianorum Pils. Pl. XXI, figs. 1, 2 (Tushkahoma), 3-8 (Limestone Gap).

P. divesta indianorum Pils., Nautilus, XIII, p. 39. Ferriss, Nautilus, XIV, p. 28 (July, 1900).

P. indianorum Pils., Proc. A. N. S. P., 1903, p. 200.

This species is still known from only a small area, the localities being as follows:

Arkansas: Poteau Mts., south of Hartford Station (Gwynr. P. O.), Sebastian Co., on steep slopes under stones (Ferriss and Pilsbry), April 5, 1903.

Indian Territory: Tushkahoma, Standley and Poteau (Ferriss); Limestone Gap (Simpson, Ferriss and Pilsbry).

At Limestone Gap, on the line of the M. K. & T. R. R., we found *P. indianorum* the commonest species, though living ones were hard to get. The shells are smaller than at Tushkahoma, rarely over 22 mm. diam., and about 60 per cent. of the whole number taken have the umbilicus more or less open. There is a perfect series of gradations from imperforate to as widely umbilicate as *P. binneyana*; only three shells of those found by Pilsbry were so open as this, and as they were specially looked for, the actual proportion is probably less than 3 per cent.

These umbilicate shells, taken by themselves, might be considered to be *P. binneyana* were it not that they connect with imperforate *indianorum* by an unbroken series of intergrades, and moreover even those most like *binneyana* have the columella perceptibly more widely dilated.

It will be seen by the table of measurements that all the specimens from Limestone Gap plotted together would form a curve with two nearly equal, strongly marked modes at the diameters 18 and 21 mm. Separated into three series according to the condition of the umbilicus, it is apparent that the *imperforate* (typical) form is larger than the *perforate*, being from 18 to 22.5 mm. diameter, with the mode at 21 mm., while the *perforate* form is from 16 to 21 mm., with the mode at 18 mm., and the few really *umbilicate* specimens are 16.3 to 16.8 mm. in diameter. This diminution of size correlated with a *perforate* or *umbilicate* axis may indicate that the Limestone Gap race is either undeveloped or retrogressive, assuming maturity while yet retaining a character of the stage of youth in the unclosed axis; the best nourished (largest) individuals attaining the normal closed umbilicus, while in those less favored the closure is imperfect, and in only the most stunted snails is the umbilicus open.

A somewhat different view would be that the Limestone Gap series is in process of diverging to form two species, one larger and imper-

forate, the other smaller and umbilicate; but as yet both characters intergrade, and all the forms certainly occur together.

Measurements of Polygyra indianorum.

Diam. in mm.	Limestone Gap.			Tushka- homa, I. T.	Poteau Mts., Ark.
	Imperfor- ate.	Perfor- ate.	Umbili- cate.		
16		1			
16.5			2		
17		2	2		
17.5		7			
18	3	13	1		
18.5	2	9			
19	5	8			
19.5	1	6			
20	6	6			
20.5	5	4			
21	14	4			
21.5	3				2
22	3				
22.5	2				
23					2
23.5					4
24				5	3
24.5					
25				6	2
25.5				1	2
26				7	1
27				3	
28				1	
28.5				1	
No. of variates	45	60	5	24	16

Polygyra indianorum lioderma Pils. Pl. XXI, figs. 14, 15.

Proc. A. N. S. Phila., 1902, p. 511.

Red Fork, Creek Co., I. T. This form is intermediate between *P. indianorum* and *P. roemeri*, being much less regularly and less distinctly striate than the former. It has not before been figured.

Polygyra roemeri (Pfr.) is a terminal member of the *divesta-indianorum* series, smoother than any of the more northern forms.

Polygyra divesta (Gld.).

This snail is now known from the following places. Names of the collectors are indicated by initials: F., Ferriss; P., Pilsbry; S., Sampson.

Missouri: Springfield, Green Co. (F.); Cedar Gap, Wright Co. (F.); Chadwick, Christian Co. (F. and P.); Seligman, Barry Co. (F.); also reported from Jasper and Dade counties (S.).

Kansas: Fort Scott, Bourbon Co. (S.).

Arkansas: Rogers, Benton Co. (F. & P.); Eureka Springs, Carroll Co. (S.); Blue Mt. Station and Magazine Mt., Logan Co. (F. & P.); Carrion Crow Mt., Pope Co. (F.); Petit Jean, Yell Co. (F.); Hot Springs, Garland Co. (F., S.); Mablevale, Pulaski Co. (C. W. Johnson); Washita Springs (Gould, type loc.); also reported from Crawford, Franklin, Sebastian and Conway counties (S.).

Indian Territory: Fort Gibson, in the Cherokee country (E. W. Hubbard, C. T. Simpson).

Louisiana: Grand Cane, De Soto Parish (Williamson).

P. divesta has been reported from Bowling Green, Ky., by Miss S. F. Price (*Nautilus*, XIV, 75), but I have not seen specimens from there and am not sure of the identification. It has also been recorded from "Vernon Co., Miss.," but there is no county of that name in the State. No reliable record of its occurrence east of the Mississippi River exists.

Throughout its range the species is very uniform in character, the diameter ordinarily being from 17 to 21 mm. At Chadwick, where nearly all land snails are dwarfed, the shells are remarkably small, a series of 23 measuring as follows:

No. of specimens.....	1	3	6	3	4	4	1	1
Diam. in mm.....	13.6	14.5	15	15.5	16	16.5	17	18

Polygyra albolabris alleni (Wetherby).

Proc. A. N. S. Phila., 1903, p. 197.

Several small series were taken in 1903 showing variations similar to those discussed in a former paper. Aside from size the shells do not vary much. The diameters are tabulated below for ten localities where we took the species in 1903.

Two large specimens from the north side of Magazine Mountain show a parietal tooth. We do not remember seeing this tooth developed in the trans-Mississippian race of *albolabris* hitherto.

The largest specimens were taken on steep, damp and rocky northern slopes, *without reference to elevation*. At Wyandotte, at an elevation of about 900 feet above the sea, they live on the steep, rocky bluff facing the river. At Magazine Mountain the series of large shells came from the edges of the talus, just under the great sandstone cliff along the northern side of the plateau summit, at an elevation of about 2,700 feet; while at an equal elevation on the dry south side, with the same sort of rock and abundant cover, the shells were small, 25 mm. diam., and at the base of the mountain still smaller, 24.5 mm. At Chadwick, where the country rock is limestone, the individuals are small, 22 to 25 mm.

The size of individuals in this species and area seems to be dependent upon the abundance of cryptogamic food, and is therefore a function of

Diam. in mm.	Chadwick, Mo.	Monett, Mo.	Mammoth Spr., Ark.	Rogers, Ark.	Magazine Mt., N. side, Ark.	Magazine Mt., S. slope, Ark.	Petit Jean Mts., Ark.	Poteau Mts., Ark.	Wyandotte, I. T.	Sugar Loaf Mt., I. T.
22	1	1	3							
22.5			3							
23	2		4				1			1
23.5	1		1				1			2
24	1						1			
24.5	1		1			2	1			1
25	1					2	2			1
25.5									1	
26				1				1	3	
26.5					2			1	1	
27					3				4	
27.5					2				2	
28				1	5				2	
28.5					1				2	
29										
29.5										
30									1	
31					1					
Total No.....	7	1	12	2	14	4	7	2	16	5

the particular station rather than related to elevation or geologic formation.

It is likely that the specimens from Seligman, Mo., which exhibited two sizes without intermediate forms, commented upon in these *Proceedings* for 1903, p. 198, were from two stations of diverse physical features.

There has also been recorded from Daingerfield, Morris Co., Tex., a small form of *albolabris*, collected by Mr. W. L. McDaniel (J. A. Singley, *Contrib. to Nat. Hist. of Texas, Mollusca*, p. 305; *Fourth Ann. Rep. Geol. Surv. of Texas*, 1892). Mr. Singley also reports that a colony of *P. albolabris* from North Carolina has been established by Mr. Askew at Tyler, Smith Co., Tex.

Polygyra zaleta ozarkensis n. subsp. Pl. XXII, figs. 26-29

Mesodon exoletus Binn., Sampson, Preliminary List of the Mollusca of Arkansas, Ann. Rep. Geol. Surv. of Ark. for 1891, II, p. 190.

The shell is smaller than *P. zaleta* (Binn.), with the spire usually more elevated, having somewhat the aspect of *P. elevata*; whorls $5\frac{1}{2}$, more slowly increasing, the last, in dorsal view, narrower. Aperture with a larger parietal tooth; columellar prominence usually well developed. Bright yellow, usually with a pink under-tint showing through on the spire. The cuticle is often partly or wholly worn from living shells.

Alt. 16.5, diam. 23 mm.

Alt. 15.5, diam. 23.5 mm.

Alt. 15.5, diam. 23 mm.

Alt. 15.5, diam. 21.5 mm.

Types No. 91,329, A. N. S. P., from Sugar Loaf Mt., Choctaw Nation, I. T., collected by Pilsbry and Ferriss, April 6 and 7, 1903.

While readily distinguishable from typical *P. zaleta* (or *exoleta*, as it is commonly known), this form has much in common with the race of northern Alabama, such as Mr. H. E. Sargent found at Woodville. In Woodville shells also the parietal tooth is very large, and the size is ordinarily that of typical *zaleta*, though occasional dwarf specimens are not larger than the Ozark race.

In fresh specimens of *P. z. ozarkensis* there is usually an appearance of angulation at the periphery in front, though no actual angle exists. The more elevated specimens might easily be mistaken for *P. elevata*, which however differs by its columellar plate, the irregular shape of the aperture and the more closely wound whorls.

Typical *P. zaleta* we have seen from Black Hawk Hollow, Fort Madison, Lee Co., Iowa (T. Van Hyning), but it has no extensive distribution in Iowa. Binney reports it from Missouri, but all the specimens before us from that State are the variety *ozarkensis*.

Binney specified no type locality for his *Helix zaleta*, merely stating that it is "common in the States bordering on the Ohio river, and in the western parts of Virginia and Pennsylvania." In order to have a definite standard, Cincinnati, O., may be considered type locality, specimens from that place agreeing well with his description and figures.

The following localities are now known for *P. z. ozarkensis*. Where no collector is mentioned the shells were taken by the authors:

Missouri: Current River; Seligman, Barry Co.; Cedargap, Wright Co.; Springfield, Green Co. (S. Weller); Chadwick, Christian Co.

Arkansas: Eureka Springs (Sampson); Mammoth Spring, Fulton Co.; Harrison, Boone Co. (Stuart Weller); Rogers, Benton Co.; Magazine Mt., Blue Mt. Station and Petit Jean Mts., Logan Co.; Mablevale, Pulaski Co. (C. W. Johnson); Little Rock; Poteau Mts., south of Gwynn P. O., Hartford Station, Sebastian Co.; Rich Mt. and Mena, Polk Co.; Little River, Little River Co. In addition to these places from which we have seen specimens, Mr. Sampson records *P. exoleta* from Washington Co.

Indian Territory: Sugar Loaf Mt., close to the western boundary of Sebastian Co., Ark.; Wyandotte.

Measurements (diameter) of Polygyra zaleta ozarkensis.

Diam. in mm.	Cedargap, Mo.	Seligman, Mo.	Mammoth Spr., Ark.	Magazine Mt., N. side	Magazine Mt., S. side.	Petit Jean Mts., Ark.	Poteau Mts., Ark.	Mablevale, Ark.	Mena, Ark.	Sugar Loaf Mt., I. T.
19			1							
20	1									
20.5	1									
21	4	1	1							1
21.5		2				2				3
22	1	2	3	3	1	3				12
22.5		1	1	6	1	2			2	5
23	1	1	1	7	3	8	5			7
23.5				9	1	1	1			
24				12	3	1	4	1		
24.5				2		1	2		1	
25				1	3	1		2	1	
No. of speci- mens	8	7	7	40	12	19	12	3	4	28

Of this species only two or three, at most, of the lots taken are sufficiently large to be expected to yield normal curves. It would seem however that there is no difference in size between shells from the shady north side of the summit of Magazine Mountain and those from its dry southern slope. The Poteau Mountain and Petit Jean Mountain lots are from northern exposures, but these mountains are rather dry. The Sugar Loaf lot is from shady, leafy ravines, but not especially well watered or damp. The snail however is not one which affects moist or rocky situations. It lives preferably on slopes leaf-carpeted over a rich humus, and rolls out of the leaves where one is raking for *Omphalina*. On the north side of Magazine Mountain we took them on the leafy slope just below the great rock-talus.

From localities in Arkansas other than those tabulated but few (one to three) specimens have been seen. They agree with those in the table with three exceptions: At Rich Mountain Mr. Ferriss took two specimens, 23.5 and 26 mm. in diam.; in Little River Co. three taken measure 24.25 and 26.5 mm.; and two from Little Rock are large and heavy, 26 and 27.5 mm. These larger shells approach the eastern *P. zaleta*, and indeed intergrade with that in size.

Polygyra elevata (Say). Pl. XXII, figs. 22-25 (Hardy, Ark.).

Sampson, Kansas City Review of Science and Industry, February, 1883, p. 551; Bull. Sedalia Nat. Hist. Soc., August, 1885, p. 19. (Sedalia, Mo.)
Moll. of Arkansas, Ann. Rep. Geol. Surv. 1891, p. 190.

Simpson, Proc. U. S. Nat. Mus., 1888, p. 450. (Fort Gibson, I. T.)
 Call, Bull. Washburn College Laboratory of Nat. Hist., I, No. 7, p. 202,
 December, 1886. (Wyandotte, Kan.)

Very few records have been made of the existence of this species west of the Mississippi River. The form from this region is in the average smaller than Eastern shells. Some care is required to distinguish it from *P. zaleta ozarkensis*. A set of fine shells from Springfield, Green Co., southwestern Missouri (A. G. Wetherby collection), is in the collection of Bryant Walker, who gives the following measurements:

Alt.	17	16.75	16	15.75	15 mm.
Diam.	21.5	20.25	19.75	20.5	20.25 "

Sampson records *P. elevata* from Sedalia, Mo. We have not seen specimens. One shell (Ferriss Coll.) was taken by Prof. Stuart Weller near or at Harrison, Boone Co., Ark., measuring 17 x 22.5 mm. At Hardy, Sharp Co., also in northern Arkansas, a series of five taken by Mr. Ferriss measure:

Alt.	15.5	16	16	17	17 mm.
Diam.	21.5	20	20.5	21.5	22 "
Whorls.	6½	6½	6½	6¾	6½

Several of these are illustrated for comparison with *P. z. ozarkensis*, from which the greater number of whorls and the oblique, straightened basal lip, usually with a tooth and notch at its outer end, distinguish *P. elevata*.

Other records from Arkansas are given by Mr. Sampson: Carroll, Crawford, Clark, Jackson Cos., and Augusta, Woodruff Co. (Call). He remarks that it is "found on low ground or adjacent thereto." *P. elevata* seems to be a species which has penetrated only the northern edge of the Ozark region. The specimens reported from Fort Gibson, I. T., should be re-examined, for they may prove to be *P. z. ozarkensis*, a form easily mistaken for *P. elevata*.

P. elevata occurs as a pleistocene fossil in the Mississippi river bluffs at Alton, Ill., and Natchez, Miss.

Polygyra thyroides (Say).

Taken by us at Chadwick, Christian Co., Mo.; Rogers, Benton Co., and Mammoth Spring, Fulton Co., Ark., and in Indian Territory at Wyandotte, Wyandotte Nation, Vinita, Cherokee Nation, and Wister, Choctaw Nation. Also at San Marcos, Hays Co., in central Texas, and reported by Ferriss from Smithville, Tex.

Polygyra clausa (Say).

Chadwick, Christian Co., Mo.; Mammoth Spring, Fulton Co., Ark.; Vinita, Cherokee Nation, I. T.

PUPILLIDÆ.

Pupoides marginatus (Say).

Rogers, Benton Co., Ark.; Limestone Gap, Choctaw Nation, I. T.

Bifidaria contracta (Say).

Rogers, Benton Co., Ark.; Limestone Gap, I. T.

Bifidaria armifera (Say).

Chadwick, Christian Co., and Monette, Barry Co., Mo.; Rogers, Benton Co., Ark.; Vinita and Limestone Gap, I. T.

Bifidaria procera (Gld.).

Rogers, Benton Co., Ark.

Bifidaria pentodon (Say).

Hillside along creek south of Blue Mountain Station, Logan Co., Ark.

Vertigo rugosula Sterki.

Limestone Gap, I. T., one specimen.

Strebilops labyrinthica texasiana Pils. and Ferr.

Wyandotte and Limestone Gap, I. T. (Ferriss and Pilsbry); Fort Gibson (Hubbard). Silver Lake, Kan., and Pottawatomie Co., Okla. (J. B. Quintard).

VALLONIIDÆ.

Vallonia parvula Sterki.

Fort Gibson, Cherokee Nation, I. T. (E. W. Hubbard, Coll. A. N. S. P.). This is the only *Vallonia* we have seen from Arkansas or Indian Territory. No other species or locality has been recorded.

CIRCINARIIDÆ.

Circinaria concava (Say).

Chadwick, Christian Co., Mo. Magazine Mt., Logan Co., Ark., north side of the summit; also on the south side.

ZONITIDÆ.

Gastrodonta ligera (Say).

We took this snail at Vinita, Cherokee Nation, I. T., in abundance. We have also seen specimens from Fort Gibson, I. T., taken by Mr. Simpson in 1888. These points mark its western limit so far as known. Mr. Sampson reports it from five counties in Arkansas (*Moll. of Ark.*, p. 182). It is not known from southern Arkansas or Texas.

In Louisiana and the adjacent part of Texas *G. intertexta* replaces *ligera* in the low country, but that species has not been found in the Ozark region.

Gastrodonta demissa brittsi (Pils.).

Zonites brittsi Pils., Nautilus, V, p. 99, 1892 (Hot Springs, Ark.).

Gastrodonta demissa var. *lamellata* Pils., Nautilus, XIII, p. 107, January, 1900 (Tushkahoma and Poteau, I. T.).

G. demissa and var. *brittsi* and *lamellata* Pils., Proc. A. N. S. Phila., 1900, p. 456; 1903, p. 213. Ferriss, Nautilus, XIV, July, 1900, p. 31.

Zonites demissa Binn., *brittsi* Pils. and *gularis* Say, Sampson, Prelim. List Moll. of Ark.; Ann. Rep. Geol. Surv. Ark. for 1891, Vol. II, pp. 182, 183, Nos. 5, 6, 16.

Zonites acerra Lewis, Simpson, Proc. U. S. Nat. Mus., 1888, p. 451 (Fort Gibson, I. T.).

The shell varies from imperforate to as widely perforate as *G. demissa*; the periphery is well rounded in adults, and the basal and outer walls of the aperture have a white callous lining, showing yellow outside on the last third of the base, the rest of the shell being olivaceous. *Young shells usually have at some stage of growth an entering callous lamella within the basal lip, at the position of the similar lamella in G. gularis.* Alt. 6.5, diam. 10 mm., whorls 6½.

Type locality, Hot Springs, Garland Co., Ark.; distribution, the Ozark uplift in Arkansas and adjacent portions of Missouri and Indian Territory.

This form has been much misunderstood, and no fewer than five names have been applied to it. It was not until the series collected by us in 1903 was studied that the problem reached solution. In any good series from one place, it is found that some shells possess the basal lamina within the mouth, and that while these shells may be of various sizes, *they fall short of the maximum size of the toothless individuals found with them.* In the fully adult shells from any colony the lamina has always been absorbed, so far as our experience goes. But specimens of any size may also want the lamina; so that the lamellate stage may be a transitory feature appearing sooner or later, or possibly it may not be developed at all in some individuals.

In one lot of 24 shells from Hot Springs, the largest one showing a lamina is 8.5 mm. in diam., and the lamina is very low, hardly noticeable. All of the 7 from this size down to the smallest (5.5 mm.) are laminate, most strongly so in the youngest. None of the larger shells (16 individuals, up to 10 mm. diam.) show a lamina. Fig. 2 represents a series of these shells, drawn to the same scale.

The types of *G. brittsi* were specimens just past the laminate stage, but still immature.

In some colonies the laminate stage persists in somewhat larger shells than above indicated.

The size of the umbilical perforation varies, and we do not now think that any racial distinction can well be based upon its variations. The

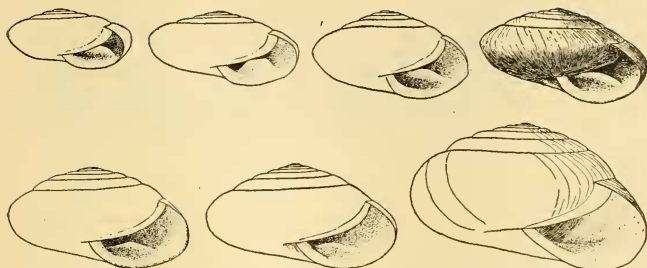


Fig. 2.—*G. d. brittsi*, Hot Springs; series showing changes with growth, $\times 4$.

subspecies differs from typical Eastern *G. demissa* chiefly by the usual development at some stage of the internal lamina, whereas we have never seen this structure in any Eastern examples of the species.

G. d. brittsi is a more primitive form than *G. demissa*, and its chief claim to renown is that it supplies the link between the toothed *Gastrodonta*s, such as *G. gularis*, and those without teeth, *G. acerra*, *cerinoidea*, *ligera* and *intertexta*, with which *demissa* has hitherto been associated. When young, *G. d. brittsi* belongs to the dentate group, but adults qualify to enter another class.¹⁹

Like the *Gastrodonta*s of the Appalachians, these Ozarkians vary interminably in minor features with locality. At Magazine Mt., Logan Co., Ark., we took it sparingly at all elevations. Also on the Petit Jean Mts., south of Magazine, where they are 9 to 10 mm. in diam., the young of 5 mm. being laminate. Also on the Poteau Mts., south of Gwynn, Sebastian Co., and on Sugar Loaf Mt., in Indian Territory, west of Gwynn, where those up to three-fourths grown are laminate.

At Chadwick, Christian Co., Mo., there is a large *acerra*-like form, diam. 12 mm., with $6\frac{1}{2}$ whorls and coarse sculpture. Only a few were taken, none being of the laminate form. The identification of this lot remains a little uncertain.

The largest specimens we have seen are from Mena, Polk Co., Ark., where they measure up to 8.5 x 14 mm., with 7 whorls. A young one, 7.5 mm. diam., is laminate, as are all those of smaller size. The

¹⁹ It may be noted that the *ligera* group was not included in *Gastrodonta* by Binney and former authors. It was transferred to that genus by Pilsbry some years ago on anatomic grounds. The conchologic connection is now established.

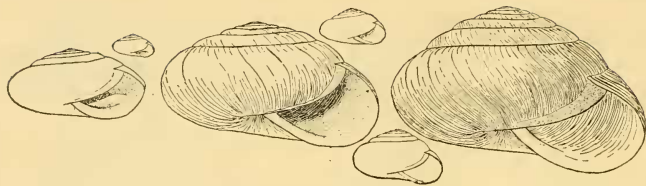


Fig. 3.—*G. demissa brittsi*, Mena, Ark. The outline figures are natural size.

adults are very similar to *G. acerra*, and doubtless it was this form which Simpson records as *acerra* in his Indian Territory list.

Numerous other localities for *G. d. brittsi* may be found in the works cited above, under the names *demissa*, *brittsi*, *lamellata*, *acerra* and *gularis*.

***Zonitoides arborea* (Say).**

Chadwick, Christian Co., Mo.; Magazine Mt. and Blue Mt. Station, Logan Co., Ark.; Vinita, Sugar Loaf Mt. and Limestone Gap, I. T.

The specimens from the summit of Magazine Mountain are small with a small umbilicus, and smoothish, glossy surface with the most delicate sculpture in place of the usual wrinkles. The very minute dense spiral striation is better developed than usual in *Z. arborea*.

***Zonitoides minuscula alachuana* (Dall).**

We took this in Logan Co., Ark., at Magazine Mountain, both on the north and south sides of the summit; very scarce. This race differs from Northern *Z. minuscula* by its much wider umbilicus. It was originally described from Alachua Co., Fla.

***Vitrea multidentata* (Binn.).**

Proc. A. N. S. Phila., 1903, p. 208, Pl. X, figs. 6, 6a.

Magazine Mt., Logan Co., Ark., on rocks in the great talus of the cliff along the northern side of the summit. The specimens are very fine and typical, usually with two rows of five or six teeth each, but some show three rows.

This is very much farther west than the species has hitherto been recorded, and is the only locality known west of the Mississippi River.

***Vitrea simpsoni* (Pils.).**

V. significans and *V. simpsoni* have no spiral sculpture, only a faint fine granulation, when examined with a high power. The radial grooves of the upper surface are weaker in *V. simpsoni* than in *V. significans*, especially on the inner whorls. We took the typical form of *V. simpsoni* at Limestone Gap, I. T., and along a creek about ten miles

southwestward. The shells measure 4.5 to 5 mm. diam. and have nearly $5\frac{1}{2}$ whorls.

At the following places a small race of *V. simpsoni* occurs. The largest shells are barely 4 mm. in diam., with 5 whorls. The umbilicus is smaller and the aperture less lengthened than in the typical form.

Missouri: Chadwick.

Arkansas: Rogers, Hardy, Blue Mountain Station, Petit Jean Mountains, Morris Ferry.

Indian Territory: Wyandotte, Poteau.

***Vitrea aulacogyra* n. sp.**

Shell similar to *V. petrophila* but very much larger, with sculpture of close, obliquely radial striae on the upper surface, the striae fine and close on the inner whorls, much coarser on the last; striae and intervening grooves about equal. Upper surface slightly convex, nearly flat. Whorls $5\frac{1}{2}$, very slowly widening, the last very much wider, rounded peripherally, the base smoothish, not distinctly striate. Aperture as in *V. petrophila*. Umbilicus slightly smaller in proportion, one-fourth the diameter of the shell.

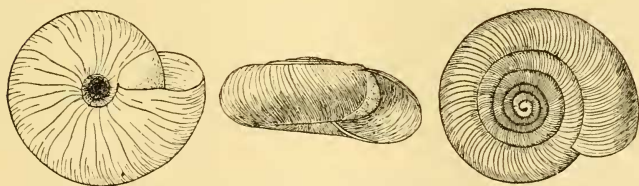


Fig. 4.—*V. aulacogyra*, $\times 4$.

Alt. 3.3, diam. 8 mm., umbilicus 2 mm. wide.

Magazine Mountain, in the talus at the north side of the summit.

This form evidently stands close to *V. petrophila*, from which it differs in the close sculpture of all the whorls and the larger size. The maximum diameter of *petrophila* in the Ozarks, judging from over 30 specimens from various places, is $5\frac{1}{2}$ mm., with $5\frac{1}{2}$ whorls, the umbilicus 1.6 mm., contained $3\frac{1}{2}$ times in the diameter. The largest Tennessee specimen before us measures 5.6 mm., with $5\frac{1}{2}$ whorls. Bland gives the diameter of *petrophila* as 6 mm., with $5\frac{1}{2}$ to 6 whorls.

V. aulacogyra is excessively rare. Only one specimen, perfect though bleached, was found.

Vitrea hammonis (Ström).

Chadwick, Mo.; Magazine Mt., Logan Co., and Rogers, Benton Co., Ark. Excessively fine spiral striæ are visible on these specimens, in a favorable light, under the compound microscope. In Eastern *V. hammonis* they are generally absent. *V. petrophila* may be distinguished from *hammonis* by its more numerous and more closely coiled whorls.

Vitrea indentata (Say).

Monett, Barry Co., and Chadwick, Christian Co., Mo. Rogers, Benton Co.; Magazine Mountain and Blue Mountain Station and Petit Jean Mountain, Logan Co., Ark. Wyandotte, Vinita, Sugar-loaf Mountain, South McAlester and Limestone Gap, Indian Territory.

In the Territory the shells are distinctly perforate (var. *umbilicata* 'Singley' Ckll.), but are not quite so large as the Texan form. It is here, as in Texas, the commonest of the smaller zonitids.

Vitrea petrophila (Bland).

Arkansas: Magazine Mountain north of the summit, Logan Co. It was found by Ferriss in 1900 at Mena, Polk Co., near the western border of the State (*Nautilus*, XIV, 30).

The specimens from Magazine Mountain differ from the types from East Tennessee in being brown in color, like *Zonitoides arborea*, while the typical form is of a pale corneous tint. There are fully $5\frac{1}{2}$ whorls. *V. p. pentadelphia* has but $4\frac{1}{2}$. This species belongs to the section *Glyphyalinia*. The westward extension of this species is unexpected. It will probably prove to be more widely spread in the Carolinian area than is now known.

Omphalina fuliginosa ('Griff.' Binn.).

Small, globose specimens were taken on the northwestern confines of the Ozark area at Wyandotte, I. T., and Rogers, Benton Co., and Poteau Mountain, south of Hartford Station, Sebastian Co., Ark. From the shells alone it would be difficult to decide upon the species, but the soft anatomy is certainly nearer *fuliginosa* than *friabilis*.

Omphalina fuliginosa ozarkensis n. subsp.

The shell is light and thin, varying from dusky olive to olive-chestnut, dusky near or at the lip. The surface is indistinctly marked with fine spiral striæ. Whorls $4\frac{1}{2}$, the earlier ones invariably worn and white or whitish. The mantle is pale gray, the branches of the vena cava black, pulmonary vein and its branches not pigmented.

Alt.	16	13 mm.
Diam.	23.3	21.5 "

Petit Jean Mountains, south from Magazine Mountain, type loc.; also Magazine Mountain, chiefly on the north side of the summit, buried in earth under dead leaves on shady hillsides, the apex only exposed. Ferriss and Pilsbry, March 28 to April 2, 1903. Also Sugar-loaf Mountain, on the boundary between Arkansas and Indian Territory.

In the field this form is instantly recognizable by the black lines of the pallial region, sharply defined against a pale ground, and readily visible through the shell. In spirit this black pigment remains unchanged.

***Omphalina friabilis* (W. G. Binn.).**

Arkansas: Mablevale, Pulaski Co. (C. W. Johnson); Rocky Comfort, Little River Co. (Ferriss, 1900). Mr. Sampson ('93, p. 181) reports *friabilis* from several other counties, but as his list does not mention *O. fuliginosa* it is almost certain that he included the two species in his records.

Texas: San Marcos, Hays Co., under dead leaves in the thicket along a rill on the northeast side of San Marcos River, abundant.

The anatomical distinctions between *O. friabilis* and *fuliginosa* will be discussed elsewhere. The shells may be distinguished by the smaller apex, narrower and more closely coiled early whorls of *friabilis*, in which moreover the apical whorls are *smooth, polished, whitish-corneous and unworn*, while the summit in southwestern *fuliginosa* is invariably worn, the cuticle removed from the earlier whorls.

***Eucynulus chersinus dentatus* (Sterki).**

Nautilus, XII, p. 116, February, 1899.

Magazine Mt., on the north side of the summit; also under stones on the hills along the creek south of Blue Mt. Station; both in Logan Co., Ark. Two young specimens from each place. This form was also taken at Hardy, Ark. (Ferriss).

These two are, we believe, the only localities known for *dentatus* west of the Mississippi.

PHILOMYCIDÆ.

***Philomysus carolinensis* (Bosc.).**

Chadwick, Mo.; Roger and Magazine Mountain, Ark.; Wyandotte, Sugar-loaf Mountain, Vinita and Wister, I. T.

ENDODONTIDÆ.

***Pyramidula alternata* (Say).**

Arkansas: Magazine Mt., Logan Co., from the summit to the base

a finely striate form with rounded periphery. At the following localities the striation is slightly coarser and the periphery weakly angular: Petit Jean Mts., Logan Co.; Poteau Mts., Sebastian Co.

Indian Territory: Wyandotte and Wister, slightly angular specimens; Sugar Loaf Mt., rounded periphery and coarse sculpture.

***Pyramidula perspectiva* (Say).**

Chadwick, Christian Co., southwestern Mo.; Arkansas, Magazine Mt., Logan Co., somewhat abundant on the north side of the summit, a few taken also on the dry southern side down to the railroad station.

At Rogers, Benton Co., Ark., a small form of *perspectiva* was found, normal in form and sculpture but only 7 mm. diam. The species is elsewhere so constant in size that this local form is noteworthy.

***Helicodiscus parallelus* (Say).**

Arkansas: Rogers, Benton Co.; Magazine Mt., Logan Co.

Indian Territory: Wyandotte, Vinita, South McAlester and Limestone Gap.

The specimens from Magazine Mt., where a large series was taken, are scarcely over 3 mm. in diameter with $4\frac{1}{2}$ whorls. Those from the Territory are slightly larger, 3.8 mm., with 5 whorls. We saw nothing of *H. fimbriatus* Weth., reported from this region by Simpson.

***Succinea avara* Say.**

Magazine Mt., north side of summit, and Petit Jean Mts., Logan Co., Ark.; Vinita, Wister and Limestone Gap, I. T.

LYMNÆIDÆ.

***Lymnæa desidiosa* Say.**

Rogers, Ark.

***Lymnæa columella* Say.**

Oklahoma City, Okla. (Ferriss).

***Planorbis trivolvis* Say.**

Rogers, northeastern Ark.; Limestone Gap, I. T.

***Ancylus kirklandi* Walker.**

Hardy, Sharp Co., Ark. (Ferriss). Erroneously reported as *A. haldemani* in these *Proceedings* for 1900, p. 457, according to Walker, *Nautilus*, XVII, July, 1903, p. 29.

In Texas we took it at New Braunfels, on rushes in Comal Creek. It was also sent from Garcitas Creek and the Guadalupe River, Victoria Co., by Hon. J. D. Mitchell (1899).

***Ancylus walkeri* n. sp.**

Shell pale corneous, thin, oval, the right and left sides equally curved;

moderately elevated, the apex depressed, radially striate, situated behind the posterior third, and much nearer the right than the left margin. Surface densely and minutely striate concentrically, and showing faint traces of radial striæ. Anterior and left slopes convex; right and posterior slopes concave. Length 4.3, width 2.75, alt. 1.4 mm.

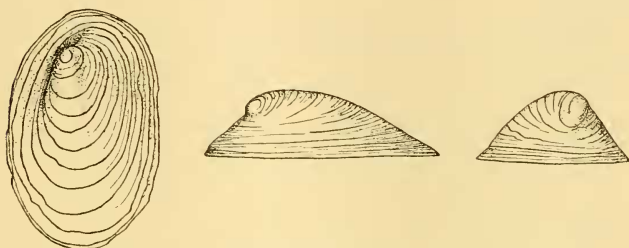


Fig. 5.—*Ancylus walkeri*.

Arkansas: Rogers, Benton Co., on fallen leaves in a fish pond, Ferriss and Pilsbry, 1903. Types No. 87,479, A. N. S. P.

This *Ferrissia* has nearly as excentric an apex as *A. excentricus*, decidedly more so than in *A. rivularis* or *tardus*. The summit of the shell is in front of the somewhat depressed apex. It is named for Mr. Bryant Walker, who has published an excellent revision of the Eastern *Ancylus*.

PHYSIDÆ.

Physa integra Hald.

Rogers, Benton Co., Ark. A brown form of the species.

Physa alboflata Anc.

Chadwick, Christian Co., Mo.; abundant and the only *Physa* found. In small rivulets it is dwarfed.

Physa rhomboidea Crandall.

Nautilus, XV, p. 44, pl. 2, figs. 6, 7, August, 1901.

Cf. A. Springer, *Proc. A. N. S. Phila.*, 1902, p. 514, pl. XXVI.

The shells we took from the stream running through Limestone Gap, I. T., agree with this form received from Mr. Crandall.

POMATIOPSIDÆ.

Pomatiopsis lapidaria (Say).

Rogers, Benton Co., Ark.

BIBLIOGRAPHY.

The following list of papers bearing on the mollusca of the Ozark uplift and region adjacent thereto is not intended to be exhaustive. It comprises most of the papers which have not been cited or referred to in the standard works, and which are essential in the study of this fauna.

1. BAKER, F. C. Note on Mollusks from Arcadia, Mo. *Nautilus*, XII, p. 36, July, 1898.
2. BINNEY, W. G., and GRAY, ARTHUR F. Notes on the Land Shells of Kansas. *Bull. Washburn College Lab. of N. H.*, Vol. I, No. 1, pp. 55, 56, January, 1885.
3. CALL, R. ELLSWORTH. Contributions to a Knowledge of the Fresh-water Mollusca of Kansas. *Bulletin of the Washburn College Laboratory of Natural History, Topeka, Kan.*
 - I. Fresh-water Bivalves. Vol. I, No. 1, pp. 49-51, January, 1885.
 - II. Fresh-water Univalves. Vol. I, No. 1, pp. 51-54, January, 1885.
 - III. Fresh-water Bivalves. Vol. I, pp. 93-97.
 - IV. Vol. I, No. 4, Oct., 1885, pp. 115-124.
 - V. Fifth Contribution to a Knowledge of the Fresh-water Mollusca of Kansas. Vol. I, pp. 177-184.
 - VI. Sixth Contribution to a Knowledge of the Fresh-water Mollusca of Kansas. Vol. II, No. 8, October, 1887, pp. 11-25. [Includes also three terrestrial species, *Succinea mooreiana*, *Ferussacia subcylindrica* and *Oliggyra occulta*.]
4. —. Description of a New Species of *Unio* from Kansas. *Bulletin of the Washburn College Laboratory of Natural History*, I, No. 2, January, 1885, p. 48, pl. 2, figs. 1-4 (*Unio popenoi*).
5. —. Notes on the Land Mollusca of the Washburn College Biological Survey of Kansas. *Bulletin of the Washburn College Laboratory of Natural History*, I, No. 7, December, 1886, pp. 201-206.
6. —. A Study of the Unionidæ of Arkansas, with Incidental Reference to their Distribution in the Mississippi Valley. *Trans. of the Academy of Science of St. Louis*, VII, No. 1.
7. CRAGIN, F. W. Miscellaneous Notes. *Bulletin Washburn College Laboratory of Natural History*, Vol. I, No. 2, pp. 83, 84 (*Unio occidentis* and *Bulimulus dealbatus* in Kansas).
8. —. A New Species of *Unio* from Indian Territory. *Bull. Washburn College Laboratory of Natural History*, II, No. 8, October, 1887, p. 6 (*Unio quintardii*).
9. FERRISS, J. F. In search of *Polygyra pilsbryi*. *Nautilus*, XIV, July, 1900, pp. 25-31.
10. —. A New *Lampsilis* from Arkansas. *Nautilus*, XIV, pp. 38, 39.
11. FORD, FRANK J. Kansas Shells. *Nautilus*, III, 105, 106.
12. MARSH, WILLIAM A. Description of Two New Species of *Unio* from Arkansas. *Nautilus*, V, 1, 2.
13. —. Description of a New *Unio* from Missouri (*Pleurobema missouriensis*). *Nautilus*, XV, p. 74, November, 1901.
14. MEEK, EUGENE SETH. A List of Fishes and Mollusks Collected in Arkansas and Indian Territory in 1894. *Bulletin U. S. Fish Commission*, Vol. XV, for 1895, pp. 341-349 (1896). The mollusks listed (p. 349) are from Old River near Greenway, in northeastern Arkansas. Sixteen bivalves and four aquatic gastropods.
15. PILSBRY, H. A. Notes on Certain Mollusca of Southwestern Arkansas. *Proc. A. N. S. Phila.*, 1900, pp. 449-459.
16. —. Mollusca of Western Arkansas and Adjacent States, with a Revision of *Paravitrea*. *Proc. A. N. S. Phila.*, 1903, pp. 193-214.

17. SAMPSON, F. A. Notes on the Distribution of Shells. Kansas City Review of Science and Industry.
 - I. Shells of Eureka Springs, Ark. Vol. V, p. 526, 1881.
 - II. Shells of Fort Worth, Tex. Vol. V, p. 681, 1882.
 - III. Shells of Sedalia, Mo. Vol. VI, February, 1883, p. 551.
 - IV. Lamar, Barton Co., Mo.; Springfield, Mo.; Eureka Springs, Ark. Vol. VI, pp. 22-25.
18. —. Shells of Pettis Co., Mo. Bulletin Sedalia Natural History Society, August, 1885, pp. 16-28.
19. —. Notes on the Distribution of Shells. American Naturalist, 1887, pp. 83-86 (On Gastropods collected in Northwestern Arkansas in March, 1886).
20. —. A Preliminary List of the Mollusca of Arkansas (exclusive of the Unionidae). Ann. Rep. Geol. Survey of Arkansas for 1891, II, pp. 179-199, 1893.
21. —. *Mesodon andreus* in Missouri. Nautilus, VI, p. 90.
22. —. Southern Shells in Missouri. Nautilus, VIII, p. 18.
23. —. Mollusca of Arkansas. Nautilus, VII, pp. 33-35.
24. —. Some Arkansas Snails. Nautilus, VIII, p. 36.
25. SIMPSON, CHARLES T. Notes on Some Indian Territory Land and Fresh-water Shells. Proc. U. S. Nat. Mus., 1888, pp. 449-454.

EXPLANATION OF PLATES XX, XXI, XXII.

- PLATE XX.—Figs. 1-5.—*Polygyra jacksoni*, Petit Jean Mountains, Ark.
 Figs. 6, 7.—*Polygyra jacksoni deltoidea*, Fort Gibson, I. T. Cotypes.
 Figs. 8, 9, 10, 11.—*Polygyra jacksoni simpsoni*, Wyandotte, I. T. Cotypes.
 Figs. 12.—*Polygyra dorfeuilliana*, Mammoth Spring, Mo.
 Figs. 13-16.—*Polygyra dorfeuilliana*, Hardy, Ark.
 Figs. 17-19.—*Polygyra dorfeuilliana sampsoni*, Wyandotte, I. T.
 Figs. 20, 21, 22.—*Polygyra dorfeuilliana perstriata*, Mena, Ark.
 Fig. 23.—*Polygyra dorfeuilliana percostata*, Red River, Ark. Cotype.
 Fig. 24.—*Polygyra dorfeuilliana perstriata*, Tushkahoma, I. T. Cotype.
- PLATE XXI.—Figs. 1, 2.—*Polygyra indianorum*, Tushkahoma, I. T.
 Figs. 3-8.—*Polygyra indianorum*, Limestone Gap, I. T.
 Figs. 9-11.—*Polygyra binneyana*, Petit Jean Mountains, Ark.
 Fig. 12.—*Polygyra binneyana*, Sugar-loaf Mountain, I. T.
 Fig. 13.—*Polygyra kiowaensis*, Magazine Mountain, Ark.
 Figs. 14, 15.—*Polygyra indianorum tiorderma*, Red Fork, I. T. Cotypes.
 Fig. 16.—*Polygyra binneyana chastatensis*, Chastat Mountains, Ark. Cotype.
 Figs. 17, 18.—*Polygyra kiowaensis* (types of var. *arkansaensis*), Hot Springs, Ark.
 Fig. 19.—*Polygyra kiowaensis*, Limestone Gap, I. T.
 Fig. 20.—*Polygyra kiowaensis*, Kiowa, I. T. Cotype.
- PLATE XXII.—Fig. 1.—*Polygyra inflecta* Say. Type.
 Figs. 2, 3.—*Polygyra inflecta*, Chadwick, Mo., form No. 1.
 Figs. 4-6.—*Polygyra inflecta*, Chadwick, Mo., form No. 2.
 Figs. 7-9.—*Polygyra inflecta*, Wyandotte, I. T.
 Fig. 10.—*Polygyra inflecta media*, Seligman, Mo. Type.
 Fig. 11.—*Polygyra edentata*, Chester, Ark.
 Figs. 12-14, 17, 18.—*Polygyra edentata magazinensis*, Magazine Mountain, Ark. Cotypes.
 Figs. 15, 16.—*Polygyra edentata* Porter, Ark.
 Figs. 19, 20, 21.—*Polygyra neglecta*, Chadwick, Mo.
 Figs. 22-25.—*Polygyra elevata*, Hardy, Ark.
 Figs. 26-29.—*Polygyra zaleta ozarkensis*, Sugar-loaf Mt. Cotypes.
 Figs. 30-32.—*Polygyra obstricta occidentalis*, Northern Ark. Cotypes.